CHAPTER 5

Generalized Software Process Model - GSPM
An Approach for General Process

There are various models in software engineering, which impose a structure on the development of a software product. Software system undergoes many stages during the lifecycle and the software process models specify standard format. In this step the software architecture for a generalized process model is presented. It begins by examining various standard and traditional software engineering process models thereby evaluating the need for an efficient and improved form of new software development method. The benefits and shortcomings of the existing traditional models are considered followed by the architecture of the new model.

Software development techniques have been using traditional software development models very intensely during the development process. Models have been used for over a long period of time and the merits and demerits directs to the need of merging different models into one. Process models play vital role in existing software engineering processes. Models can be used to develop more precise and formalized descriptions of software life cycle activities.

Various traditional software process models widely used in the software development industry are Waterfall Model, Incremental Model, RAD (Rapid Application development) Model, Prototyping Model, and Spiral Model.
5.1 GENERALIZED SOFTWARE PROCESS MODEL

The traditional process models have been studied and analyzed for their shortcomings; the proposed work presents new concepts so as to eliminate shortcomings and introduce new method for taking decision.

The Generalized Software Process Model designed as follows is modeled for the optimization of the process that will help the software development team to work with greater efficiency and effectiveness. To alleviate the key limitations of the traditional process models, a general process model can be employed. Recently, agile methods are used and they provide and promote iterative development where small iterations are carried out. The GSPM – Generalized Software Process Model takes the concept of parallelism between different operations to reduce cycle time. Key contribution is that the concept has been formalized and a conceptual framework is provided to speed up execution of instructions in processors. We have also employed this process model successfully for executing real life projects.

We believe that the process model is a workable approach for executing projects where there is need of delivering working system quickly. This model has a stable architecture. The benefit drawn from this model is that it has a well-defined system in which requirements are well understood at the beginning of the project before the development starts. This ultimately results in the production of reusable components and quick development of the product. This model incorporates short development cycles thereby helping the user to evaluate the product quickly and the development becomes faster and efficient. The risk of project failure is also very low as it has clear, stable and specific objectives. The model is flexible therefore it is less costly to change the scope and requirements. Testing and debugging for smaller iterations are easy to manage. User feedback is given importance that results in a cost effective development.
In this chapter we propose an approach to perform process modeling. Using this model the problem is broken down into sub problems that result in reduced complexity. This is helpful with projects having uncertain and vague user requirements. Risks are detected earlier in the project; this speeds up the progress of the project. Because of constant feedbacks the effectiveness tends to be high. Efficiency of the project goes high. System becomes more reliable with the customers’ involvement in the project at subsequent intervals.
Project Leader initiates communication with customer by sending Technical Personnel

Project Leader discusses the customer requirements with the Technical Personnel

Requirements are gathered based on previous similar projects
SRS developed

Copy of SRS sent to the customer

Changed requirements are gathered by the Project Leader from customer

Analysis of required work by Project Leader

Feasibility study by the team
Figure 5.1 Generalized Software Process Model – GSPM
In GSPM, as in other development the process begins by initiating communication with customer or stakeholder by sending a representative. All project requirements are gathered from the customer and in case, there is some change expected then also customer is contacted for further discussion. The Project Leader makes analysis of the collected requirements.

Once the Project Leader is satisfied by the analysis then feasibility study takes place involving the team members. First prototype is developed and is given to the customer for evaluation. Evaluation of design, code is done at the customer end. Any comments from the customer are taken care of, the work is reviewed and again the work is redone which is followed by the unit testing.

Each stage performs some clearly defined task of the iteration and produces a clearly defined output. The output of one work is the input of another work in sequence. The model requires that duration of each stage, that is, the time required to complete the task is same approximately. Another prototype is developed till there are no further requirements or changes demanded by the customer. In case all the unit tests are performed then the integration testing takes place. Finally, the system testing takes place and the system is delivered to the customer. After deployment the maintenance phase takes place whenever needed.

There is a dedicated team for each stage. This makes the working smoother and understandable as every team has a dedicated work to look after and perform. Usually, same team does the work needed at various different stages.

Each stage performs some logical activity and there exists extensive communication amongst the team members and the stakeholders. The team members are expected to communicate and meet on regular intervals. It is also expected that once a work
product is said to be completed then the team needs to communicate minimally with
the previous team for performing their task hence there is hardly any significant effect
on the work of any teams.

5.2 BASIC STRUCTURAL MODEL FOR GSPM

In the basic structural model for GSPM, the structural activities and alternatives are
defined which identify the components of the system. These basic components give
an overview of the basic functioning of the complete system and it’s dependency
amongst the various components. This user-interface system divides the complete
system into three components:

1. **Communication Dependent Component**: It comprises of communicating
   with the customer. It is specific and is related to a particular application, also it
   is not intended to be reused in other applications. This component includes the
   functional core activity of the application. Here the formal talk with the
   customer takes place.

2. **Shared Interface Component**: It consists of the code that supports the
   interface of multiple applications program. Depending upon the talks with the
   user, the Project Leader and Software Architect or Designer performs the
   feasibility study. Multiple programs can be run in parallel to reduce the
   construction time.

3. **Application Specific Component**: It consists of code that is specifically
   concerned to a particular class and is not application specific. Here the code
   that is to be implemented is written.
5.3 DATA FLOW DIAGRAM FOR A GENERALIZED PROCESS MODEL

The application input is fed at the site of the customer and an interaction between the customer and the company’s representative takes place. The transactions / talk are edited by the Project Leader or the Architect of the software. Project is either considered for rejection or for editing. The edited project is considered for design purpose and a design is made on its basis. The user studies the generated project design and he updates the architect. Either the first prototype is made or based upon the suggestion of the user a new prototype is made. The user validates design in order to reduce the risk of getting into incorrect and bad design. A new project design can also be made in parallel depending upon the user / customer’s requirement.

Important aspect of this model is that the customer is involved in this phase that is, customer has to verify the requirements to make it sure that developer is moving in the right direction. Once all the prototypes are generated and customer is satisfied the final coding takes place along with the system testing and the project is delivered at the customer’s site. In the last step the maintenance part is taken care of.
Figure 5.3 Data Flow Diagram for a Generalized Process Model
5.4 INTERNAL STRUCTURE OF A GENERALIZED SOFTWARE PROCESS MODEL

The internal structure of a GSPM includes project or transaction as the driver program, which is common to all applications. Further, it includes various subprograms that consist of, next update or revision of the contents and project unique functions. Furthermore, the subprogram functions are specific to one application or project. These subprograms check the basic consistency, job access, job validation and job posting.

Subprogram functions (specific to one application / project)

Figure 5.4 Internal Structure of a Generalized Software Process Model
Today interactive technology demands continuous processing. This internal structure shows that all processes have standard set of subprograms that check the transaction request; accesses required data, validate transaction and places the result. [185]

5.5 CASE STUDY

5.5.1 E-Governance projects

E-Governance is the use of information and communication technologies in public with the aim of improving information, encouraging citizen participation in the decision-making process and making government more accountable, transparent and effective. Usage of software in e governance gives data integrity, accuracy and duplication of the work is reduced. Also the integration amongst various branches is achieved with reusability of data; processing information has become fast and error free. Considerable cost cutting has been achieved as activities and records are managed and monitored in a better way. It also helps to achieve transparency of information across all offices at various locations.

E government is made to use IT for improving the ability of government to address the needs of society. It includes publishing of policy and programme related information to convey to the citizens. It provides on-line services and covers the use of IT for strategic planning.

Some projects created much hype around preliminary success but were not much helpful in sustainable, successful implementations. One must be careful not to create expectations that cannot be fulfilled, leading to cynicism about the computerization initiatives. [187, 189,192,193,196,198,199,202-204,206]
The e-government projects have not come out to be very much successful in India because of certain issues, of which one being the technology issue related to hardware and software. It is seen that various bodies of Governments function autonomously, thus it is likely that they might go in for heterogeneous hardware / software platforms.
and the integration of the data and integration of subsets of these applications on a common platform may pose a problem in the near future.

Large complex centralized projects may also lead to project failure as the cross departmental linkages are difficult to implement. Projects which spread over different levels of Government are usually complex and complicated. The integration of Central and State Government is not only complex but difficult to implement. Therefore the existence of such projects is important. The projects have to be implemented with proper planning otherwise these large, complex and centralized systems may fail to deliver the desired local needs. [188, 190, 191, 195, 197], 201, 205

Some of the projects which did not prove to be much successful in their approach are given as below.

1. The Gyandoot E-Government Project in India
In 2000 the Madhya Pradesh state government in India designed e-government ICT development project in the rural Dhar district. The idea and intentions of the project were to meet the needs of poor local populations by bringing services and information near to them and thereby cutting down the travel time and costs. But the design lacked practical consideration of the context in which the kiosks were installed. The idea was very creative and involved the integration of several key issues (government services, ICT development, education, etc), still many factors and issues were not integrated into the design.

2. The e-FIR E-Government Project in India
This project was started in Rajasthan for electronic filing of the first investigation report. The aim was that the person filing the investigation report could file it electronically and later approach the police station. But due to lack of the architectural issues the project was not very successful.
3. The **LokMitra and JanMitra E-Government Project** in India

e-Mitra Project integrates LokMitra and JanMitra initiatives to bring all the departments together and give citizens of the state a multi-service under single-window. LokMitra was an urban centric project whereas JanMitra was a rural centric e-enabled service delivery system. Now, the functional features have been improved. It combines best features of both LokMitra and JanMitra. This enhanced service includes more departments including private sector services. It uses uniform interchange architecture.[186]

![Figure 5.6 Working of e Mitra](image-url)
5.5.1.1 Benefits derived using GSPM (Generalized Software Process Model)

After studying the above projects a need for a new approach is desired. The suggested new approach should prove to be a success for the projects. Till now in the failed projects various reasons like wrong time estimation, no resource planning (including staff, systems, skills of employees are not used properly), failure to identify, plan and develop complex functionalities, are not engineered properly.

Technical risks generally lead to failure of functionality and performance, the causes of technical risks being, continuous changing requirements, no new or advanced technology available, product is too complex to implement and modules integration is difficult. Design flaws, block the pipeline flow through which information and communication travels such as incompatibilities between systems.

e Government systems and services have frequently failed or performed poorly because of inadequate design. Incompatibilities in hardware, software or networking infrastructures within and between the public agencies are most common. Also, there are flaws in the user interface or usability of systems that can hamper the ways agencies interface with citizens and businesses. Lack of interoperability between disparate computer systems unable to work together and share data. These operational problems can discourage public from trying e Government opportunities.

This approach will provide bottom-up structured approach to the initial design, implementation and evaluation processes would increase sustainability and overall success of the project. The data architecture which is an overall plan for the data items (and their relationships) necessary to deliver has been taken care of.
Process architecture has also been defined which is the planning of the key activities. Technology architecture has been incorporated which tells how computers will be sized and connected, also an outline of the software to be used is suggested. Data management architecture shows how data input, processing, storage and output functions will be divided across the information technology architecture.

The above study gave the opportunity to analyse the advantages and shortcomings prevailing to the traditional and standard models which are and have been used extensively in the industry for commercial use, in the defence area, in the various fields whatsoever; and in this path of research it strengthens the view to form a generalised model which shall overcome the shortcomings and help to generate the workflow in a smooth manner with ease. Here, a new method for software life cycle model has been developed. This model should be helpful in the e governance process for easier repository and easier access with secured aspects of the system.

5.5.2 Student information system using Spiral model

The Student Information System was developed at Birla Institute of Technology, Mesra, Ranchi, Extension Centre Jaipur by a group of students undergoing their project work in Master of Computer Application [MCA]. In this system the records of the students are stored which help in generating various reports as needed by the administration department of the college.

This model is developed using the Spiral approach of the traditional software development life cycle. The system starts with filling of the forms by the student for collecting the basic information of the student. A customized report is generated listing the selected students based on the selection procedure of the college. The Project Incharge of the Student Information System [SIS] verifies the result and the details of the selected students.
Figure 5.7 Student Information System Using Spiral Model

- Student fills form
- Selection on basis of Rank and Percentage
- Preparation of details and verification by Project Leader
- Personal information
- Educational information
- Verification of details by Project Leader
- Integration
- Test
- Implementation

Report 1: List of selected students
Report 2: Educational aid on the basis of family income
Report 3: Medical Report
Report 4: Toppers List
On the basis of the personal details various reports like, Financial Aid to students and Medical Reports of students are generated. Thereafter, using the educational details of students a report of toppers is generated listing the names of toppers of each class. The above work is done sequentially. Next, all the existing modules that are used for Personal Information as well as for the Educational Information are integrated and then tested by the Project Incharge.

Using the above methodology, risk assessment costs more than development because the verification of the unit is done only when the unit is completely developed, hence in case of any change or errors there is no reverting back until the end of the development of that unit. In smaller projects everytime the requirements are new, changes have to be incurred in every unit whenever needed, thereby making the project highly customized and limits re-usability. As we are not emphasiszing on the feedback by the user, using this approach, the chances of errors increase and this results in risk of not meeting the budget or the schedule.
5.5.3 Student information system using GSPM (Generalized Software Process Model)

The Student Information System was developed at Birla Institute of Technology, Mesra, Ranchi, Extension Centre Jaipur by a group of students undergoing their project work in Master of Computer Application [MCA]. In this system the records of the students are stored which help in generating various reports as needed by the administration department of the college.

This model is developed using the new GSPM (Generalized Software Process Model). The system starts by filling up of forms by the student, for collecting the basic information of the student. A customized report is generated which lists the selected students based on the selection criteria of the college. A notification for verification is sent back to the student who verifies his details. This helps in confirming that now the software can proceed with correct details and that the time will not be wasted in re-verification of the details later. This procedure of taking feedback from the customer / student imbibes satisfaction in them. The software developer later stores the details in the software database.

The stored details are used for generating various reports as required by the administration department. The confirmation is once again sought from the customer / client / student about the information before starting the development work or the work of processing reports. This work is carried out in parallel, thereby, saving the time of software development.
Figure 5.8 Student Information System using GSPM (Generalized Software Process Model)
This also reduces the chance of meeting errors as the verification has been conducted at the unit level. Since work is conducted concurrently, this increases the productivity and reduces the production time. The proposed strategy also helps in reducing the defects and drastically improves schedule deliveries.

GSPM provides easy to use approach, which implies, releasing the software analysts to worry about the models correctness. The reusability reduces redundancies, which reflects on producing better quality.